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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	Evgeniya Freydina et al.
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For:	WATER TREATMENT SYSTEM AND METHOD
Examiner:	Joseph W. Drodge
Art Unit:	1723

Certificate of Mailing under 37 C.F.R. § 1.8

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/elias domingo/
Elias Domingo

Commissioner for Patents

APPELLANT'S BRIEF PURSUANT TO 37 C.F.R. § 41.37

Dear Sir:

This Appeal Brief is filed in response to the Office Action made Final mailed on May 16, 2007. A fee of $510 under C.F.R. § 41.20(a)(2) is being paid herewith.

Any additional fees that are required for consideration of this paper, including any extension fees, are authorized to be charged to Deposit Account No. 50/2762.

Table of Contents

I. Real Party in Interest (37 C.F.R. § 41.37(c)(1)(i))

The real party in interest in this application is the assignee, Siemens Water Technologies Holding Corp., having a place of business at 181 Thorn Hill Road, Warrendale, Pennsylvania 15086 (hereinafter "Appellant").

II. Related Appeals and Interferences (37 C.F.R. § 41.37(c)(1)(ii))

There are no other appeals, interferences, or judicial proceedings known to Appellant, Appellant's legal representatives, or assignee that are related to, will directly affect, be directly affected by, or have a bearing on the Board's decision in this pending appeal.

III. Status of Claims (37 C.F.R. § 41.37(c)(1)(iii))

Claims 1-22 were originally filed in this application. In a Response mailed May 18, 2006 (in response to an Office Action dated February 22, 2006), claims 23-26 were submitted but not entered. In a Response mailed October 5, 2006 (in response to an Office Action dated July 5, 2006), claims 11, 17, and 22 were amended, claim 21 was canceled, claim 27 was added, and claims 23-26 were withdrawn from consideration without prejudice or disclaimer as being drawn a non-elected invention. In a Response filed March 28, 2007 (in response to an Office Action dated November 28, 2006), claims 2, 21, and 23-26 were canceled, claims 1, 4, 8, 11, 13, 15, and 17 were amended, and claims 28-32 were added.

The claims pending in this application are independent claims 1, 11, 17, and 22 along with dependent claims 3-10, 12-16, 18-20, and 27-32.

Dependent claims 3-10 and 28 depend directly or indirectly from independent claim 1. Dependent claims 12-16 and 27 depend directly or indirectly from independent claim 11. Dependent claims 18-20 and 29-32 depend directly or indirectly from independent claim 17.

Each of pending claims 1, 3-20, 22, and 27-32 was rejected in a final Office Action dated May 16, 2007.

Appellant appeals the rejection of claims 1, 3-20, 22, and 27-32. A copy of the appealed claims as pending is attached as a Claims Appendix.

The status of the claims is as follows:

A. Claims 1-3, 8-10, and 12 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Hark in U.S. Patent No. 4,808,287 (hereinafter "Hark") in view of Batchelder et al. in U.S. Patent No. 6,126,805 (hereinafter "Batchelder");

B. Claims 11, 12, 13, and 27 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Hark in view of Batchelder and Rela in U.S. Patent No. 6,607,668 (hereinafter "Rela");

C. Claims 4-7, 11-20, 22, and 27-32 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Hark in view of Batchelder and additionally in view of Tamura et al. in U.S. Patent No. 6,303,037 (hereinafter "Tamura"), and Rela.

IV. Status of Amendments (37 C.F.R. § 41.37(c)(1)(iv))

Claims 1-22 were originally filed in this application.

In a Response mailed May 18, 2006, claims 23-26 were submitted but not entered.

In a Response mailed October 5, 2006, claims 11, 17, and 22 were amended, claim 21 was canceled, claim 27 was added, and claims 23-26 were withdrawn from consideration without prejudice or disclaimer as being drawn a non-elected invention.

In a Response filed March 28, 2007, claims 2, 21, and 23-26 were canceled, claims 1, 4, 8, 11, 13, 15, and 17 were amended, and claims 28-32 were added.

No claims have been amended after the final Office Action dated May 16, 2007.

A copy of the claims as pending, incorporating any prior amendments and showing the status of each of the claims, is attached as a Claims Appendix.

V. Summary of Claimed Subject Matter (37 C.F.R. § 41.37(c)(1)(v))

The subject matter of the present invention is directed generally to a system and method of treating water and, more particularly, to a water treatment system incorporating an electrochemical device designed and operated to treat water while minimizing water polarization. (Specification at page 1, lines 7-9.)

FIGS. 1 and 3 (reproduced below) show embodiments of water treatment system 10 of the present invention, comprising an electrochemical device 16 which removes undesirable species from water to be treated. Water treatment system has a reservoir 12 fluidly connected to a water source or point of entry 14 and to a point of use 18. Treatment system 10 can have a sensor 20 and a controller 22 for controlling or regulating a power source 24, which typically provides power to electrochemical device 16. Undesirable species removed by device 16 can be transferred to an auxiliary use, such a lawn sprinkler system, or a drain 26. Water treatment system 10 can comprise a pretreatment system 28 and fluid control components such as manifolds, conduits, pumps and valves.

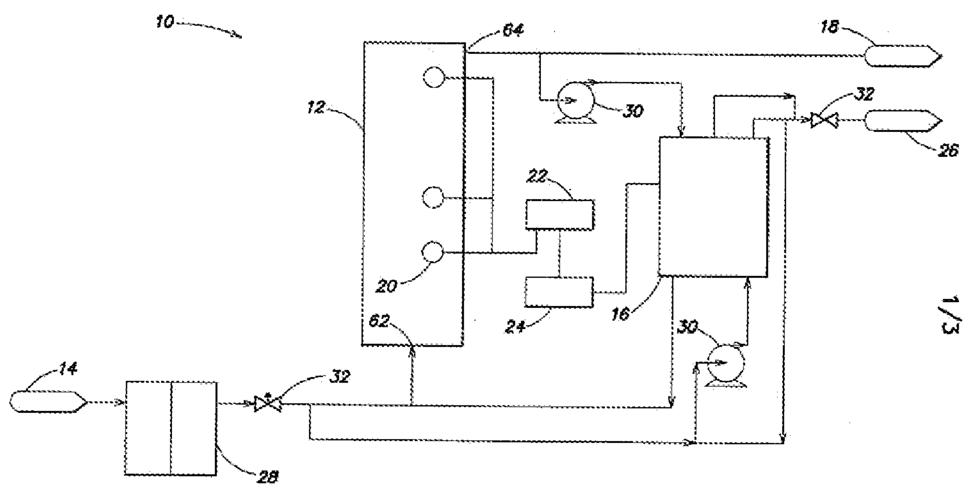


FIG. 1

During operation, an electrical field, *e.g.*, electrical current, is applied across electrochemical device 16. In some cases, controller 22 regulates power source 24 to supply the applied electric field to electrochemical device 16 with an applied voltage and current

below the limiting current density or would not create conditions that split water. (Page 9, lines 1-17 and page 15, lines 22 *et seq.*)

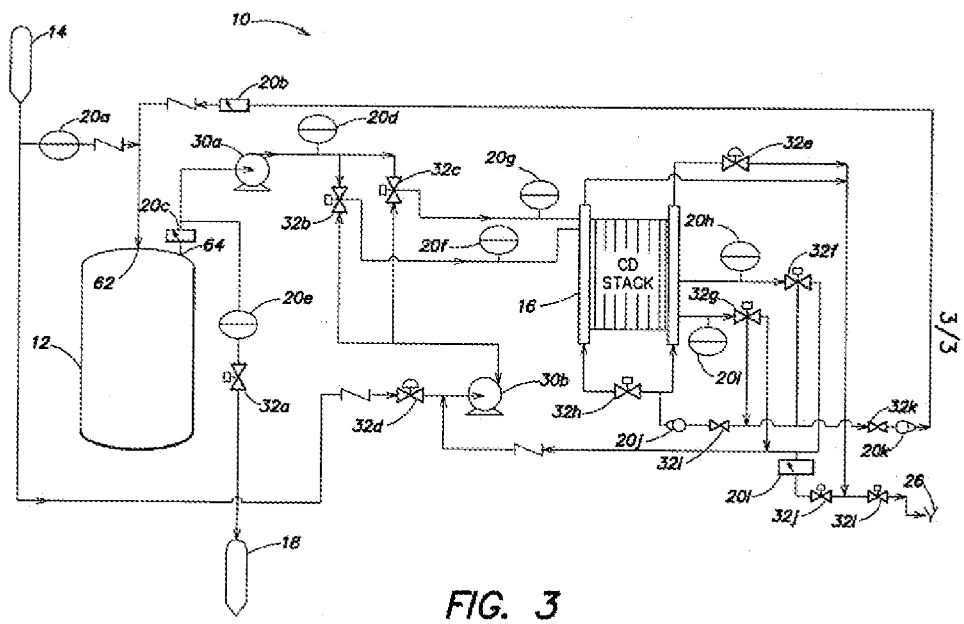


FIG. 3

The subject matter of independent claim 1 is directed to a method of producing treated water. The method comprises introducing water from a point of entry 14 into a reservoir system 12 and an electrochemical device 16, removing at least a portion of any undesirable species from the water in the electrochemical device 16 while suppressing hydroxyl ion generation to produce treated water; storing at least a portion of the treated water in the reservoir system 12, and distributing at least a portion of the water from the reservoir system to a point of use 18. Support for the subject matter of independent claim 1 is provided at page 2, line 30 to page 3, line 2 of the Specification as originally filed. Further particular support for the subject matter of independent claim 1 is provided at page 9, lines 25 *et seq.*, at page 15, line 22 to page 16, line 4; and at page 11, lines 4-20 of the Specification as originally filed.

The subject matter of independent claim 11 is directed to a method of producing treated water. The method comprises introducing water from a point of entry 14 into a reservoir 12, introducing a portion of the water from the reservoir 12 into an electrochemical device 16, applying an electrical current below a limiting current density through the

electrochemical device 16 to promote removal of any undesirable species from the water and produce treated water, and maintaining the electrical current below the limiting current density to produce the treated water. Support for the subject matter of independent claim 11 is provided at page 3, lines 3-8 of the Specification as originally filed. Further particular support for the subject matter of independent claim 11 is provided at page 9, line 25 to page 11, line 3; and at page 15, line 22 to page 16, line 4 of the Specification as originally filed.

The subject matter of independent claim 17 is directed to a water treatment system 10. The water treatment system 10 comprises a reservoir system 12 fluidly connected to a point of entry 14, the reservoir system 12 comprising a plurality of zones having water contained therein with differing water quality levels, an electrochemical device 16 fluidly connected to the point of entry 14 and the reservoir system 12, a power supply 24 for providing an electrical current to the electrochemical device 16, and a controller 22 for regulating the electrical current below a limiting current density. Support for the subject matter of independent claim 17 is provided at page 3, lines 9-13. Further particular support for the subject matter of independent claim 17 is provided at page 9, line 25 to page 11, line 3; at page 15, lines 9-21; at page 13, lines 7-21; and at page 15, line 22 to page 16, line 4 of the Specification as originally filed.

The subject matter of independent claim 22 is directed to a method of facilitating water treatment. The method comprises providing a pressurizable reservoir system 12 fluidly connectable downstream of to a point of entry 14 and further fluidly connectable upstream of a distribution system fluidly connect to at least one point of use 18, providing an electrochemical device 16 fluidly connected downstream of the pressurizable reservoir system 12, providing a power supply 24 for providing an electrical current to the electrochemical device 16, and providing a controller 22 for regulating the electrical current below a limiting current density. Support for the subject matter of independent claim 22 is provided at page 3, lines 14-19. Further particular support for the subject matter of independent claim 22 is provided at page 9, line 25 to page 11, line 3; at page 15, lines 9-21; at page 13, lines 7-21; and at page 15, line 22 to page 16, line 4 of the Specification as originally filed.

In summary, support for the subject matter of independent claims 1, 11, 17, and 22 are provided at least at page 4, line 30 to page 5, line 28; at page 6, lines 15-28; at page 9, lines 25-30; at page 10, lines 17-30; at page 11, lines 16-20; and at page 15, line 22 to page 16, line 4 of the Specification as originally filed. Support for a reservoir system having a plurality of zones is provided at page 15, lines 9-21 of the Specification as originally filed.

VI. Grounds of Rejection to be Reviewed on Appeal (37 C.F.R. § 41.37(c)(1)(vi))

A. Whether claims 1, 3, 8-10, and 12 are unpatentable under 35 U.S.C. § 103(a) over Hark in view of Batchelder.

B. Whether claims 11, 12, 13, and 27 are unpatentable under 35 U.S.C. § 103(a) over Hark in view of Batchelder and Rela.

C. Whether claims 4-7, 11-20, 22, and 27-32 are unpatentable under 35 U.S.C. § 103(a) over Hark in view of Batchelder, Tamura, and Rela.

VII. Argument (37 C.F.R. § 41.37(c)(1)(vii))

A. Discussion of the Prior Art

1. Hark in U.S. Patent No. 4,808,287

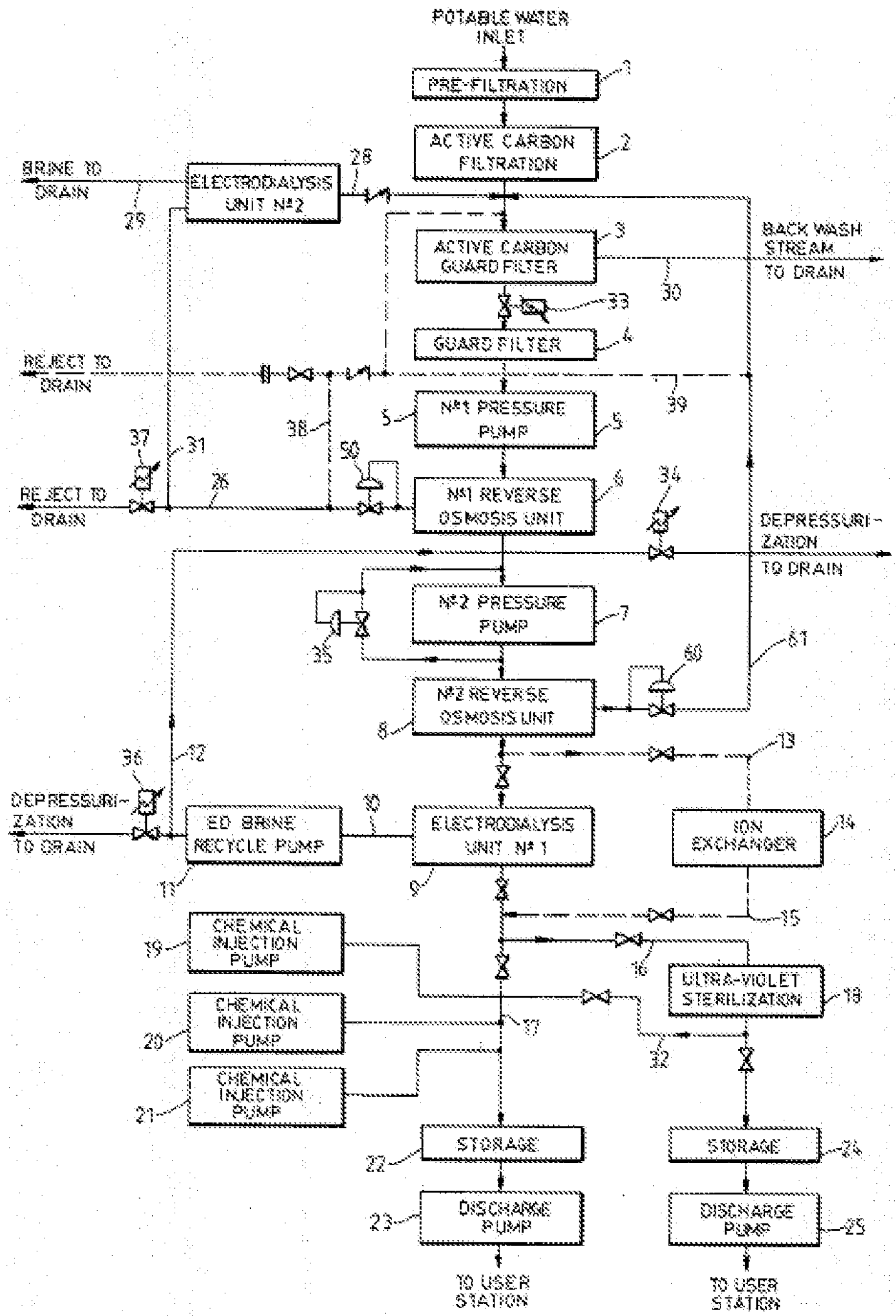
Hark discloses a water purification process involving treating potable water from a municipal water supply to remove suspended solids, organic and inorganic dissolved solids, dissolved carbon dioxide gas, and metal contaminants to produce ultra-pure water (at least 16 megohm-cm^{-1}). (Abstract.)

With reference to FIG. 1 (reproduced below), the first step of the process involves municipal water entering into pre-filtration chamber 1, which removes suspended solids. (Column 2, lines 34-50.) Water from pre-filtration chamber 1 is then introduced into an activated carbon unit 2, which absorbs organic materials, chlorine, and hypochlorite. (Column 2, lines 51-56.) From activated carbon unit 2, any remaining contaminants in the water is removed by an activated carbon guard filter 3, which is similar to activated carbon unit 2 except that cartridges of carbon guard filter 3 can be replaced. (Column 2, lines 61-66.) To prevent contamination of downstream reverse osmosis membranes, filtered water from guard filter 3 is passed through a second guard filter 4 to remove any activated carbon particles from carbon beds 1 and 3. (Column 3, lines 1-6.) Water from guard filter 4 is pressurized by a first reverse osmosis pressure pump 5 before being introduced into a first reverse osmosis unit 6. (Column 3, lines 6-9.)

First reverse osmosis unit 6 removes up to about 95 % of impurities. (Column 3, lines 24-30.) Reject brine water from first reverse osmosis unit 6 can be directed to drain or diverted into an electrodialysis unit 27, which reduces the contaminant level therein to a level equal to or less than the level of contaminants in the municipal feed water. (Column 3, lines 40-43.) Brine water from electrodialysis unit 27 is discharged to drain by way of line 29 and "clean" water stream from unit 27 is introduced into the municipal feed water stream, downstream of activated carbon filter 2. (Column 3, lines 40-51.)

Permeate water from first reverse osmosis unit 6 is re-pressurized by a second pressure pump 7 before being delivered to a second reverse osmosis unit 8, which further

removes impurities. (Column 3, line 67-column 4, line 17.) Brine water from second reverse osmosis unit 8 is recycled into the municipal feed water stream at a point upstream of activated carbon filter 3. (Column 4, lines 25-31.) Permeate product is then delivered to an electrodialysis unit 9. (Column 4, lines 23-24.)



Electrodialysis unit 9 has platinum anode and cathode electrodes to allow reversal of the applied electric current. (Column 4, lines 37-41.) To maintain accurate power requirements and to prevent overvoltage or hydrogen overvoltage, electrodialysis unit 9 has a "Poggendorf" compensation method potentiometer that continuously monitors power requirements for cleaning contaminants deposited on the electrodes. (Column 4, lines 44-50.) Brine water from electrodialysis unit 9 is pressurized by an ED brine recycle pump 11 and then directed into the suction line of second pressure pump 7. (Column 4, lines 51-54.)

Additives can be added to permeate water from electrodialysis unit 7 and then stored prior to delivery to a user, or permeate water can be stored in storage after being treated by an ultra-violet sterilization unit 18. (Column 4, lines 58-65.) The permeate outlet stream from second reverse osmosis unit 8 depressurizes through deionization filters into the product storage tanks. (Column 5, lines 41-43.)

2. Batchelder et al. in U.S. Patent No. 6,126,805

Batchelder discloses an improved electrodialysis (ED) device with any of cation exchange membranes having ion exchange groups predominantly sulfonic acid groups and a minor amount of weakly acidic and/or weakly basic groups or membranes which are selective to monovalent cations and simultaneously, cation exchange granules selective to monovalent cations as packing in the dilute compartments; anion exchange membranes having as ion exchange groups only quaternary ammonium and/or quaternary phosphonium groups and substantially no primary, secondary and/or tertiary amine and/or phosphine groups or membranes which are selective to monovalent anions simultaneously therewith, anion exchange granules selective to monovalent anions as packing in the dilute compartments; and, as packing in the dilute compartment, anion exchange granules which are selective to monovalent anions, or cation exchange granules which are selective to monovalent cations, or cation exchange granules having as exchange groups a predominant amount of sulfonic acid groups and a minor amount of weakly acidic and/or weakly basic groups, or anion exchange granules consisting of organic polymers having as anion exchange

groups only quaternary ammonium and/or quaternary phosphonium groups and almost no primary, secondary and/or tertiary amine and/or phosphine groups. (Abstract.)

Batchelder describes prior art ED devices as having a multiplicity of alternating anion selective and cation selective membranes. (Column 1, lines 24-27.) The use of ion exchange (IX) membranes with high ion perm-selectivity, low electrical resistance and excellent stability led to use thereof in ED devices for desalting brackish water, concentration of sea water, and de-ashing of cheese whey. (Column 1, lines 27-36.) Batchelder notes the several limitations of ED devices: ED devices have a limiting current density and poor removal of weakly ionized species. (Column 1, line 37 to column 4, line 7.)

Batchelder notes that because the ion exchange membranes used in ED devices are highly selective to ions of one sign or the other, a substantial fraction of the ions passing through the membranes must diffuse from the bulk solution through laminar flowing layers at the interfaces between the membranes and the solutions being depleted of ions (the "dilute or diluting solutions or streams" as known in the art). (Column 1, lines 38-45.) The maximum rate of diffusion occurs when the concentration of electrolyte at such membrane interfaces is essentially zero, at the limiting current density. (Column 1, lines 45-49.) To increase the limiting current density, the rate of diffusion can be increased by reducing the thickness of the laminar flow layers, by flowing the bulk solution rapidly by the membrane surfaces, and/or by the use of turbulence promoters. (Column 1, lines 49-53.) Practical limiting current densities are generally in the range of 5,000 to 10,000 amperes per square meter for each kilogram-equivalent of salts per cubic meter of solution (0.5 to 1 amperes per square centimeter for each gram-equivalent per liter). (Column 1, lines 53-58.)

Typical brackish water has a concentration of salts of about 0.05 kg-eq/m^3 (0.05 eq/l or about 3000 parts per million (ppm)), corresponding to a limiting current density in the range of from about 250 to 500 amperes per m^2 (0.025 to 0.05 amperes/cm^2). (Column 1, lines 58-62.)

Significantly, Batchelder notes that "to maximize the utilization of ED devices it is desirable to operate at the highest possible current densities" but, as the limiting current density is approached, water dissociates ("split") into hydrogen ions and hydroxide ions, at

the interfaces between the (prior art) anion exchange membranes and the diluting streams. (Column 1, line 62 to column 2, line 2.) Hydrogen ions pass into the diluting streams and the hydroxide ions into the adjacent solutions which are being enriched in ions (the "concentrate, concentrated, concentrating or brine solutions or streams"). (Column 2, lines 2-6.)

Batchelder notes that there is a tendency for calcium carbonate to precipitate at those surfaces of the conventional anion exchange membranes, which are in contact with the concentrating streams because brackish water typically has calcium bicarbonate and explains that chemical or ion exchange softening of the feed waters (the brackish water) or the concentrating streams by adding acid thereto, by de-carbonation of the streams, and/or by regularly reversing the direction of the applied electric current are techniques that have been utilized to address such tendencies. (Column 2, lines 6-19.)

Batchelder discloses that the theory of limiting current in ED devices shows that, in the case of sodium chloride solution, the cation exchange membranes should reach their limiting current density at values which are about two-thirds that of the anion exchange membranes. (Column 2, lines 20-24.) The difference is believed to result from catalytic water dissociation by weakly basic amines in anion exchange membranes. (Column 2, lines 29-33.)

Batchelder then concludes that splitting of water at conventional anion exchange membranes at or near their limiting current densities is an unfortunate phenomenon, unavoidable for practical purposes. (Column 2, lines 41-44.) When the limiting current density is exceeded ED devices with "conventional" cation exchange membranes, there is little water splitting but at convention anion exchange membranes, as the limiting current density is approached or exceeded, a substantial fraction of the applied current is carried by the water dissociation products, hydrogen ion and hydroxide ions. (Column 4, lines 40-55.)

At column 8, lines 17 *et seq.*, Batchelder discloses that:

> In the case of filled cell electrodialysis operating in the highly polarized mode and in which the dilute compartments are packed with roughly equal equivalents of anion exchange and cation exchange granules, the required water splitting occurs at bipolar junctions in which the anion exchange resin (granule or membrane) is roughly on the anode side of the junction (and obviously the cation exchange resin, granule or membrane, is roughly on the

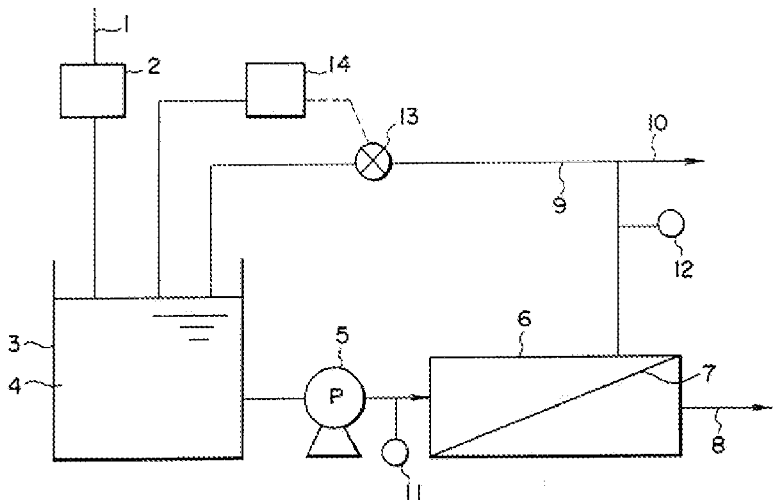
> cathode side of the junction). The potential losses found in filled cell electrodialysis appear to indicate that there is only about 1 water splitting bipolar junction in each current path. (The potential loss at each such junction is about 0.8 volts). It also appears that much of the water splitting is occurring at junctions between conventional anion exchange membranes and conventional cation exchange granules. The performance of ED or filled cell ED can be "tailor-made" to suit the application by judicious choice among:
> conventional water splitting anion exchange membranes;
> reduced water splitting anion exchange membranes according to this invention;
> conventional, low water splitting cation exchange membranes;
> enhanced water splitting cation exchange membranes according to this invention;
> conventional water splitting anion exchange granules;
> reduced water splitting anion exchange granules according to this invention;
> conventional low water splitting cation exchange granules;
> enhanced water splitting cation exchange granules made in accordance with the chemistries discussed above.

3. Tamura et al. in U.S. Patent No. 6,303,037

Tamura discloses a reverse osmosis process for treating water containing silica and hardness ions into permeate water product and concentrate water. In the process, silica precipitation is inhibited by maintaining the pH of the concentrate at no more than 6 pH units. (Abstract and column 2, lines 21-32.)

In FIG. 2 (reproduced below), Tamura discloses a reverse osmosis process receiving city water through inflow piping 1 into a feed water tank 3 after being passed through an activated carbon filter 2. (Column 4, lines 56-60.) Feed water 4 in tank 3 is withdrawn and pressurized by a high-pressure pump 5 before being introduced into a reverse osmosis membrane module 6. (Column 4, lines 60-63.) Pressurized feed water is treated in module 6 to produce a permeate water passed through reverse osmosis membrane 7 of the module 6 and a concentrate with increased silica and hardness ions concentrations. (Column 4, line 63 to column 5, line 3.) Permeate water is withdrawn from the system by way of withdrawal piping 8. (Column 5, lines 4-5.) A portion of the concentrate is directed to feed water tank 3 by way of circulation piping 9 and the balance thereof is drained out of the system by way of branch piping 10. (Column 5, lines 5-9 and lines 38-40.)

FIG. 2



A feed water pressure gauge 11 is disposed between pump 5 and reverse osmosis membrane module 6; and a concentrate pressure gauge 12 is positioned in circulating piping 9 between reverse osmosis membrane module 6 and branch piping 10. (Column 5, lines 11-14.) A pH sensor 13, positioned in circulating piping 9 between branch piping 10 and feed water tank 3, is connected to a chemicals feed pump 14. (Column 5, lines 14-17.) The pH of the concentrate, as measured by sensor 13, is used to control the flow rate of hydrochloric acid delivered by chemicals feed pump 14 to maintain the pH of the concentrate at a level of about 4.5 units. (Column 5, lines 17 *et seq.*)

4. Rela in U.S. Patent No. 6,607,668

Rela discloses, with reference to FIGS. 1 and 12 (reproduced below), a water purifier having an integrated system that controls the components thereof. The water purifier includes a plurality of unit operations that represent stages in the water purification process. (Column 2, lines 39 *et seq.*) Supply water is pretreated by directing it into a sediment pre-filter module 10, a softener module 20, and a sediment removal and dechlorination module 28b. (Abstract and column 2, lines 46-52.) The pre-treated water is supplied to a reverse osmosis module 46 which separates the water into two streams, a purified water stream and a concentrate stream. (Column 2, lines 52-57.)

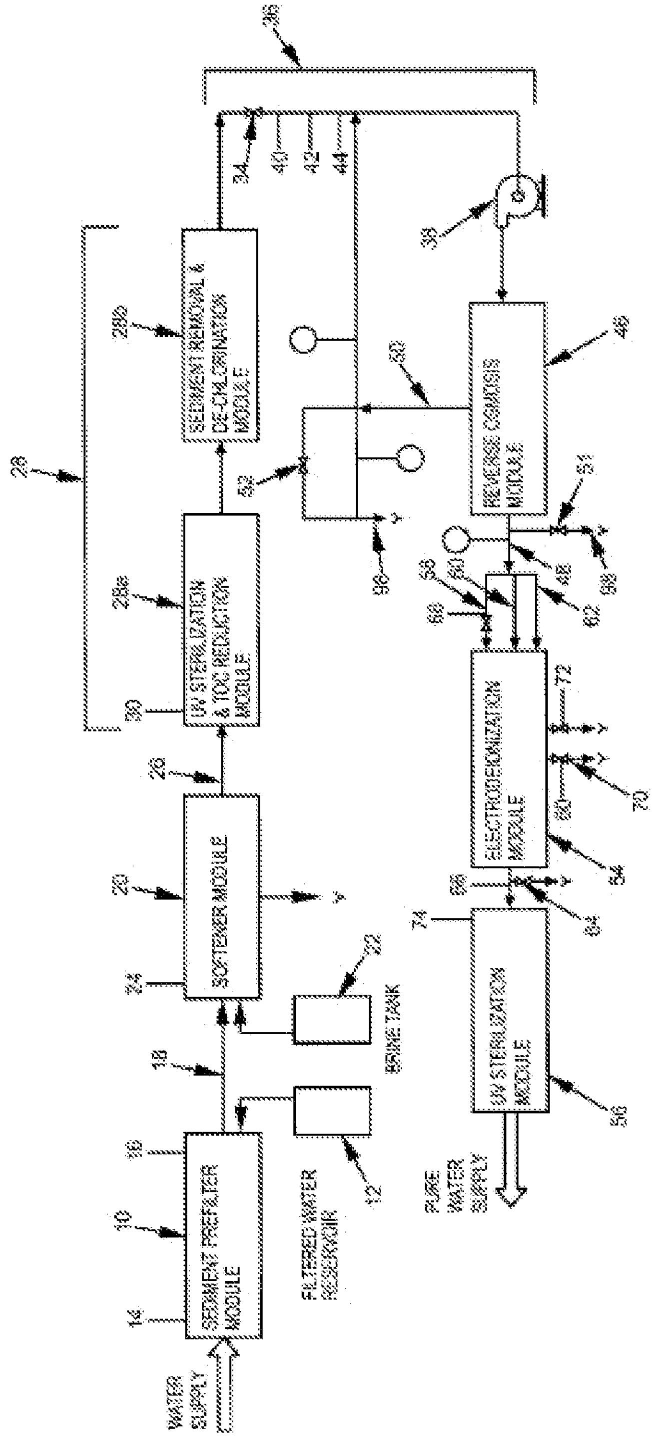


FIG. 1

The purified water is passed to an electrodeionization module 54 which further purifies the water. Purified water is also further treated in an ultraviolet sterilization module 56. (Column 2, lines 57-61.) The sediment pre-filter module incorporates an automated

cleaning or backwashing feature to flush the ceramic elements therein to remove accumulated particles from the surfaces of the ceramic elements. (Column 5, line 66 to column 6, line 14.) Flushing the ceramic elements is performed at predetermined intervals by utilizing a high velocity water stream from a pure water reservoir in a direction opposite to the direction of the flow of supply water through the tubular element housing. (Id.)

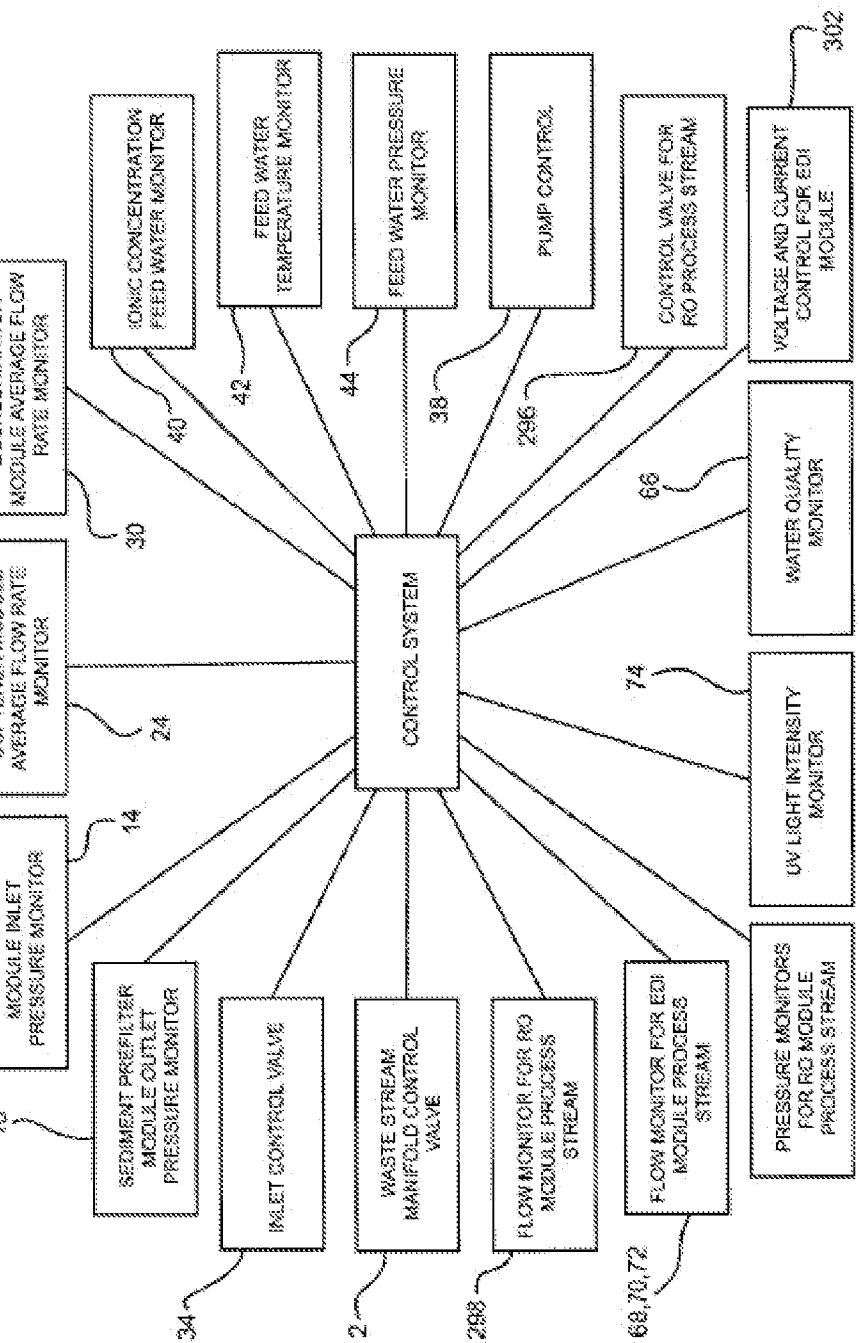


FIG. 12

A water quality monitor 66 measures ionic concentration in the pure water outlet from the electrodeionization module, which the control system utilizes to calculate electrical voltage and current directed so that optimum outlet water quality is achieved. (Column 3, lines 62-67.) Control of the electrodeionization module entails measuring the flow rate and pressure of process streams, electrode streams, and concentrate streams in the module. (Column 4, lines 43 *et seq.*) Controlling may further involve measuring various parameters of the system. (Column 4, lines 56 *et seq.*)

Rela thus discloses integrating the various unit operations of a water purification system under the control of a controller as schematically depicted in FIG. 12 (reproduced below).

B. Claims 1, 3, and 8-10 are not unpatentable under 35 U.S.C. § 103(a) over Hark in view of Batchelder

Claims 1, 3, and 8-10 would have been obvious to one having ordinary skill in the art over Hark in view of Batchelder.

Hark discloses a water purification process in which potable water from a municipal supply is treated to remove suspended solids, organic and inorganic dissolved solids, dissolved carbon dioxide gas and metal contaminants to produce ultra-pure water. The process involves pre-filtration of the water, activated carbon filtration, secondary guard filtration, and double reverse osmosis ("RO") treatment of the water; and an electrodialysis unit is used to further remove impurities in the water. (Hark at Abstract.) Hark explains that 96 % of the impurities are removed in a first RO system in the incoming water stream and 96 % of the impurities of the outlet from the first RO system are removed in a second RO system. (Hark at column 2, lines 49 *et seq.*) The majority of impurities in the incoming water stream are removed by the sequentially arranged reverse osmosis devices, and the electrodialysis unit is used as a polishing device to ensure that the produced ultra-pure water has a resistivity of at least 16 megohm-cm^3.

The rejection is improper as failing to provide a *prima facie* case of obviousness because, *inter alia*, no valid motivation has been presented to modify the system disclosed by

Hark and incorporate the disclosure of Batchelder. 35 U.S.C. § 103(a), MPEP §§ 2141, 2142 ("To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.")

Hark explains that the electrodialysis unit has electrodes that allow cleaning off contaminants and buildup and that the unit is operated to prevent overvoltage or hydrogen overvoltage. (Hark at column 4, lines 42 *et seq.*) It is clear that Hark acknowledges that the electrodialysis unit is operated in a manner that generates hydroxyl ions by directing operating the unit in a manner that removes precipitating products, from a reaction with hydroxyl ions. A person skilled in the art would therefore recognize that no further technical solution would have been necessary to address products resulting from reactions with generated hydroxyl ions. Indeed, one skilled in the art would recognize that the device disclosed by Hark must operate by splitting water.

Batchelder discloses that for applications involving filled cell electrodialysis, and reversing electrodialysis, "it would be desirable therefore to have cation exchange membranes which split water near or above their limiting current densities" for <u>clean water</u>. (Batchelder at column 6, line 52 to column 7, line 17.) To that end, Batchelder provides cation exchange membranes which have, in at least those two surfaces in contact with a liquid in diluting compartments of an electrochemical apparatus, a predominant amount of strongly acidic cation exchange groups in a comparatively minor amount of weakly acidic and/or weakly basic groups that <u>facilitate water splitting at currents near or above their Cowan-Brown limiting currents</u> roughly similar to the water splitting exhibited by conventional anion exchange membranes near or above the limiting currents. (Batchelder at column 7, lines 20, *et seq.*)[1]

[1] For example, Batchelder discloses electrodialysis stacks having cation exchange membranes with sulfonic acid groups and weakly acidic and/or basic groups; anion exchange

To treat potable water, Batchelder discloses techniques, systems, and components that seek to split water to form hydrogen and hydroxyl ions. Indeed, the techniques of Batchelder run against suppressing hydroxyl ion generation, especially when treating already purified water, as is the water treated from the reverse osmosis train of Hark.

Thus, contrary to what is alleged, Batchelder explicitly teaches that "[i]n order to maximize the utilization of ED apparatus it is desirable to operate at the highest possible current densities." (Batchelder at column 1, lines 62 *et seq.*, emphasis added.) Batchelder thus fails to provide any motivation to suppress hydroxyl ion generation while removing undesirable species from the water to be treated and discredits the erroneous and speculative assertion that "it would have been obvious for one of ordinary skill in the art to have controlled the EDI process in the Hark system by operating near or below the limiting current density to minimize water splitting, or formation of hydroxyl ions, as taught by Batchelder, to further limit the amount of precipitation occurring on the EDI surfaces and downstream of the device especially in the concentrating stream, so as to optimize the EDI operation in removal of salts and other contaminants." (At the first full paragraph of page 4 of the final Office Action.)

The references thus fail to provide any suggestion or motivation of a method comprising acts or steps of introducing water from a point of entry into an electrochemical device and removing at least a portion of any undesirable species from the water in the electrochemical device while suppressing hydroxyl ion generation to produce treated water. Thus, an ordinarily skilled artisan relying on Hark and Batchelder would not have suppressed hydroxyl ion formation but, instead, would have been motivated to split water.

Further, Hark and Batchelder fail to disclose a method of producing treated water comprising "introducing water from a point of entry into a reservoir and an electrochemical

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membranes with quaternary ammonium and/or quaternary phosphonium groups and no primary, secondary, and/or tertiary amine and/or phosphine groups; and, as packing in dilute compartments, anion exchange granules which are selective to monovalent anions, or cation exchange granules which are selective to monovalent cations, or cation exchange granules with exchange groups being predominantly sulfonic acid groups and a minor amount of weakly acidic and/or weakly basic groups.

device" as recited in independent claim 1. Hark discloses storing treated water but does not disclose introducing or storing water from a point of entry into a reservoir as well as into an electrochemical device. Batchelder is silent as to storing water from a point of entry or even as to treated water and any alleged combination of Hark and Batchelder could not result in a method of treating water comprising each and every element in the manner recited in independent claim 1.

Thus, even if the references could have been combined, any resultant combination would have failed to disclose or suggest a method of producing treated water comprising each and every element in the manner recited in independent claim 1. Therefore, the *prima facie* case of obviousness of independent claim 1 over Hark in view of Batchelder is improper.

Dependent claims 3 and 8-10 depend from independent claim 1. These dependent claims would also not have been obvious over Hark and Batchelder for at least the same reasons discussed above. Significantly, Hark and Batchelder fail to disclose or suggest a method producing treated water comprising storing at least a portion of the treated water in a pressurized reservoir system. To be sure, Hark at column 5, lines 44-46 does not disclose or suggest a pressurized reservoir or tank but instead explains, at column 5, lines 41-45, that "[t]he permeate outlet stream from the second reverse osmosis unit 8 depressurizes via the deionization filters into the product storage tanks."[2]

The examiner appears to speculate that by virtue of the "reservoirs or tanks being maintained full of water," the reservoir must necessarily be pressurized. This specious conclusion, however, ignores the express disclosure of Hark that the permeate outlet stream from the second reverse osmosis unit 8 depressurizes via the deionization filters into the product storage tanks.

[2] Notably, Hark discloses discharge pumps 23 and 25 downstream from storage 22 and 24 which suggests to a person of ordinary skill in the art that the stored product water cannot be delivered based only on stored pressure, if any.

Therefore, the alleged *prima facie* case of obviousness over Hark in view of Batchelder is defective because the references fail to disclose or suggest each and every element recited in dependent claims 3 and 8-10.

At the second full paragraph of page 4 of the final Office Action, dependent claim 12 appears to be rejected as obvious over Hark and Batchelder.[3] Dependent claim 12 depends from independent claim 11 which has not been rejected as obvious over Hark in view of Batchelder. Accordingly, the rejection of dependent claim 12 over Hark in view of Batchelder is defective.

C. Claims 11, 12, 13, and 27 are not unpatentable under 35 U.S.C. § 103(a) over Hark in view of Batchelder and Rela

Independent claim 11 would not have been obvious over Hark in view of Batchelder and Rela. The rejection is also improper as failing to provide a *prima facie* case of obviousness because, *inter alia*, no motivation has been presented to modify the system disclosed Hark by incorporating the disclosure of Batchelder and because any alleged combination of these references would fail to disclose each and every element in the manner recited in independent claim 11.

As noted, Hark discloses a water purification process in which potable water from a municipal supply is treated to remove suspended solids, organic and inorganic dissolved solids, dissolved carbon dioxide gas and metal contaminants to produce ultra-pure water. Hark acknowledges that the electrodialysis unit is operated in a manner that generates hydroxyl ions by instructing operating the unit in a manner that removes precipitating products, from a reaction with hydroxyl ions.

As also noted above, Batchelder discloses that for applications involving filled cell electrodialysis, and reversing electrodialysis, "it would be desirable therefore to have cation

[3] This paragraph reads:

> For claims 2,8,9, 12 [sic] the treated water is stored in reservoirs 22 and 24 under some degree of pressure may be pressurized , by way of pressure imparted by upstream pumps 7 and 19-21 and the reservoirs or tanks being maintained full of water (Hark at column 5, lines 44-46).

exchange membranes which split water near or above their limiting current densities" for clean water. (Batchelder at column 6, line 52 to column 7, line 17.) To that end, Batchelder provides cation exchange membranes with a predominant amount of strongly acidic cation exchange groups in a comparatively minor amount of weakly acidic and/or weakly basic groups that facilitate water splitting at currents near or above their Cowan-Brown limiting currents in electrochemical devices. Significantly, Batchelder explicitly notes that "[i]n order to maximize the utilization of ED apparatus <u>it is desirable to operate at the highest possible current densities</u>." (Batchelder at column 1, lines 62 *et seq.*, emphasis added.)

Rela fails to cure the deficiencies of Hark and Batchelder. Rela discloses a water purifier having an integrated system that controls the components of the system. The water purifier includes a plurality of unit operations that represent stages in the water purification process. Supply water is pretreated by directing it into a sediment pre-filter module, a softener module, and a sediment removal and dechlorination module. (Rela at Abstract.) The pre-treated water is supplied to a reverse osmosis module which separates the water into two streams, a purified water stream and a concentrate stream. The purified water is passed to an electrodeionization module which further purifies the water. Purified water is further treated in an ultraviolet sterilization module. The sediment pre-filter module incorporates an automated cleaning or backwashing feature to flush the ceramic elements therein to remove accumulated particles from the surfaces of the ceramic elements. (Rela at column 5, line 66 to column 6, line 14.) A water quality monitor measures ionic concentration in the pure water outlet from the electrodeionization module, which the control system utilizes to calculate electrical voltage and current directed so that optimum outlet water quality is achieved. (Rela at column 3, lines 62-67.) Control of the electrodeionization module entails measuring the flow rate and pressure of process streams, electrode streams, and concentrate streams in the module. Controlling may further involve measuring various parameters of the system. Rela fails to advance the gravamen of the obviousness rejection based on Hark and Batchelder because Rela does not disclose or suggest a method of treating water comprising applying an electrical current below a limiting current density through an electrochemical

device to promote removal of any undesirable species from the water to produce the treated water.

Thus, an ordinarily skilled artisan, relying on the disclosures of these references, would not have sought to operate an electrochemical device with an applied electrical current below the limiting current density.

Further, Hark, Batchelder, and Rela fail to disclose or suggest a method of producing treated water comprising "introducing water from a point of entry into a reservoir" and "introducing a portion of the water from the reservoir into an electrochemical device" as recited in independent claim 11. Indeed, Hark, Batchelder, and Rela fail to disclose or suggest a method of producing treated water comprising "maintaining the electrical current below the limiting current density to produce the treated water" as further recited in independent claim 11. To be sure, none of the references recognizes the advantages of maintaining the electrical current below the limiting current density.

Thus, any combination of Hark, Batchelder, and Rela could not disclose each and every element recited in independent claim 11 in the manner claimed. MPEP §§ 2141, 2142 (The prior art references must teach or suggest all the claim limitations.)

Therefore, the alleged *prima facie* case of obviousness over Hark in view of Batchelder and Rela is improper.

Dependent claims 12, 13, and 27 depend directly or indirectly from independent claim 11. For at least the reasons noted above, these claims would not have been obvious over the Hark in view of Batchelder and Rela. Notably, none of these references discloses a method of producing treated water comprising providing treated water mixed with water from a point of entry.

D. Claims 4-7, 11-20, 22, and 27-32 are not unpatentable under 35 U.S.C. § 103(a) over Hark in view of Batchelder and further in view of Tamura and Rela

Claims 4-7 and 28 would not have been obvious over Hark in view of Batchelder and in further in view of Tamura and Rela. These claims depend directly or indirectly from

independent claim 1 which, as noted above, cannot be unpatentable over Hark in view of Batchelder and Rela.

As also explained above, independent claim 11 would not have been obvious over Hark in view of Batchelder, or over Hark in view of Batchelder and Rela. Dependent claims 12-16 and 27 depend from independent claim 11 and, for at least the same reasons noted, also would not have been obvious over the disclosures of these references.

Tamura discloses regulating the pH of the concentrate from a reverse osmosis device to prevent silica precipitation on the membranes of the reverse osmosis device. Thus, Tamura cannot repair the improper *prima facie* case of obviousness of independent claims 1 and 11 over Hark in view of Batchelder, or over Hark in view of Batchelder and Rela, because Tamura also fails to provide any disclosure or suggestion for a method of treating water comprising each and every step in the manner recited in these independent claims.

Therefore, dependent claims 4-7, 12-16, and 27-28 would also not have been obvious over Hark in view of Batchelder and further in view of Tamura and Rela.

Independent claim 17 is directed to a water treatment system comprising a reservoir system fluidly connected to a point of entry, the reservoir system comprising a plurality of zones having water contained therein with differing water quality levels; an electrochemical device fluidly connected to the point of entry and the reservoir system; a power supply for providing an electrical current to the electrochemical device; and a controller for regulating the electrical current below a limiting current density.

The alleged *prima facie* case of obviousness of independent claim 17 is defective because none of Hark, Batchelder, Tamura, and Rela discloses or suggests a reservoir system fluidly connected to a point of entry, wherein the reservoir system comprises a plurality of zones having water contained therein with differing water quality levels.

Dependent claims 18-20 and 29-32, which depend directly or indirectly from independent claim 17, also would not have been obvious over Hark in view of Batchelder and further in view of Tamura and Rela.

Independent claim 22 would also not have been obvious over Hark in view of Batchelder and further in view of Tamura and Rela because the references fail to disclose or suggest each and every element in the manner recited. As noted above, the alleged *prima facie* case of obviousness over Hark in view of Batchelder is improper because one skilled in the art would not have controlled an electric current applied to an electrochemical device utilized for water treatment in the manner claimed. Tamura and Rela also fail to disclose or suggest this aspect of the invention. The *prima facie* case of obviousness is also defective because none of the references discloses or suggests a method of facilitating water treatment comprising providing a pressurizable reservoir system fluidly connectable downstream of a point of entry and further fluidly connectable upstream of a distribution system that is fluidly connected to at least one point of use and providing an electrochemical device fluidly connected downstream of the pressurizable system.

Tamura appears to disclose a reservoir system; there is, however, no explicit disclosure that would lead one skilled in the art to realize the tank would necessarily be pressurizable. Indeed, in the figures, Tamura depicts an open top tank which implies that the tank cannot necessarily be pressurizable. Further, Tamura discloses a reverse osmosis device fluidly connected downstream of reservoir system but fails to disclose or suggest providing a water treatment system comprising providing <u>an electrochemical device</u> fluidly connected <u>downstream</u> of a pressurizable reservoir system. Thus, the *prima facie* case of obviousness of claim 22 over these references cannot be supported by any combination of these references.

E. <u>Conclusion</u>

For the reasons provided herein, each of the rejections is improper and should be reversed. Appellant respectfully requests reversal of the rejections and issuance of a Notice of Allowance.

VIII. Claims Appendix: Claims as Appealed (37 C.F.R. § 41.37(c)(1)(viii))

Listing of Claims

1. (Previously Presented) A method of producing treated water comprising:

introducing water from a point of entry into a reservoir system and an electrochemical device;

removing at least a portion of any undesirable species from the water in the electrochemical device while suppressing hydroxyl ion generation to produce treated water;

storing at least a portion of the treated water in the reservoir system; and

distributing at least a portion of the water from the reservoir system to a point of use.

2. (Canceled)

3. (Original) The method of claim 1, wherein removing the at least a portion of any undesirable species while suppressing hydroxyl ion generation comprises applying an electrical current below a limiting current density.

4. (Previously Presented) The method of claim 1, further comprising measuring at least one water property of at least a portion of the water in the reservoir system.

5. (Original) The method of claim 4, further comprising adjusting an operating parameter of the electrochemical device based on the measured water property.

6. (Original) The method of claim 4, further comprising distributing at least a portion of the treated water to a point of use based on the measured water property.

7. (Original) The method of claim 4, further comprising adjusting a flow rate of the water into the electrochemical device based on the measured water property.

8. (Previously Presented) The method of claim 1, wherein the act of storing at least a portion of the treated water comprises storing at least a portion the treated water in a pressurized reservoir system.

9. (Original) The method of claim 8, wherein storing the treated water in the pressurized reservoir system comprises storing the treated water in a treated water zone of the pressurized reservoir system.

10. (Original) The method of claim 1, wherein the electrochemical device comprises an electrodeionization device.

11. (Previously Presented) A method of producing treated water comprising:

introducing water from a point of entry into a reservoir;

introducing a portion of the water from the reservoir into an electrochemical device;

applying an electrical current below a limiting current density through the electrochemical device to promote removal of any undesirable species from the water and produce treated water; and

maintaining the electrical current below the limiting current density to produce the treated water.

12. (Previously Presented) The method of claim 11, further comprising storing the treated water in the reservoir.

13. (Previously Presented) The method of claim 12, further comprising measuring a water property of water in the reservoir.

14. (Original) The method of claim 13, wherein applying the electrical current comprises adjusting the electrical current based on the measured water property.

15. (Previously Presented) The method of claim 14, wherein introducing water from the point of entry into the reservoir comprises adjusting a water flow rate based on the measured water property.

16. (Original) The method of claim 15, further comprising distributing at least a portion of the treated water to a point of use.

17. (Previously Presented) A water treatment system comprising:

a reservoir system fluidly connected to a point of entry, the reservoir system comprising a plurality of zones having water contained therein with differing water quality levels;

an electrochemical device fluidly connected to the point of entry and the reservoir system;

a power supply for providing an electrical current to the electrochemical device; and

a controller for regulating the electrical current below a limiting current density.

18. (Original) The system of claim 17, further comprising a distribution system fluidly connected downstream of the reservoir system and to a point of use.

19. (Original) The system of claim 17, further comprising at least one water property sensor.

20. (Original) The system of claim 19, wherein the electrochemical device comprises an electrodeionization device.

21. (Canceled)

22. (Previously Presented) A method of facilitating water treatment comprising:

providing a pressurizable reservoir system fluidly connectable downstream of to a point of entry and further fluidly connectable upstream of a distribution system fluidly connect to at least one point of use;

providing an electrochemical device fluidly connected downstream of the pressurizable reservoir system;

providing a power supply for providing an electrical current to the electrochemical device; and

providing a controller for regulating the electrical current below a limiting current density.

23. (Canceled)

24. (Canceled)

25. (Canceled)

26. (Canceled)

27. (Previously Presented) The method of claim 11, further comprising a step of providing treated water mixed with water from the point of entry.

28. (Previously Presented) The method of claim 10, further comprising measuring a plurality of water quality levels of the water in the reservoir system.

29. (Previously Presented) The system of claim 17, wherein at least a portion of the reservoir system is pressurized.

30. (Previously Presented) The system of claim 29, wherein the controller is further configured to regulate delivery of water from at least one of the zones to at least one point of use.

31. (Previously Presented) The system of claim 17, wherein the controller is further configured to receive at least one signal representative of at least one water quality level of at least one zone and regulate the electrical current based at least partially on the at least one signal.

32. (Previously Presented) The method of claim 22, further comprising a step of connecting the controller to at least one water property sensor disposed in the pressurizable reservoir system.

IX. Evidence Appendix (37 C.F.R. § 41.37(c)(1)(ix))

None.

X. Related Proceedings Appendix (37 C.F.R. § 41.37(c)(1)(x))

None.

XI. Conclusion

For the reasons provided above, the rejections are improper and should be reversed. Appellant respectfully requests reversal of the rejections and issuance of a Notice of Allowance.

If there is a fee occasioned by this paper, including an extension fee that is not covered by an enclosed check, please charge any deficiency to Deposit Account No. 50/2762.

Respectfully submitted,
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